



ISD Technical Review (Code 581)

Swift Overview & Status

July 21, 2004

M. Rackley



Agenda



Overview

Spacecraft Status

Ground System/Operations Status

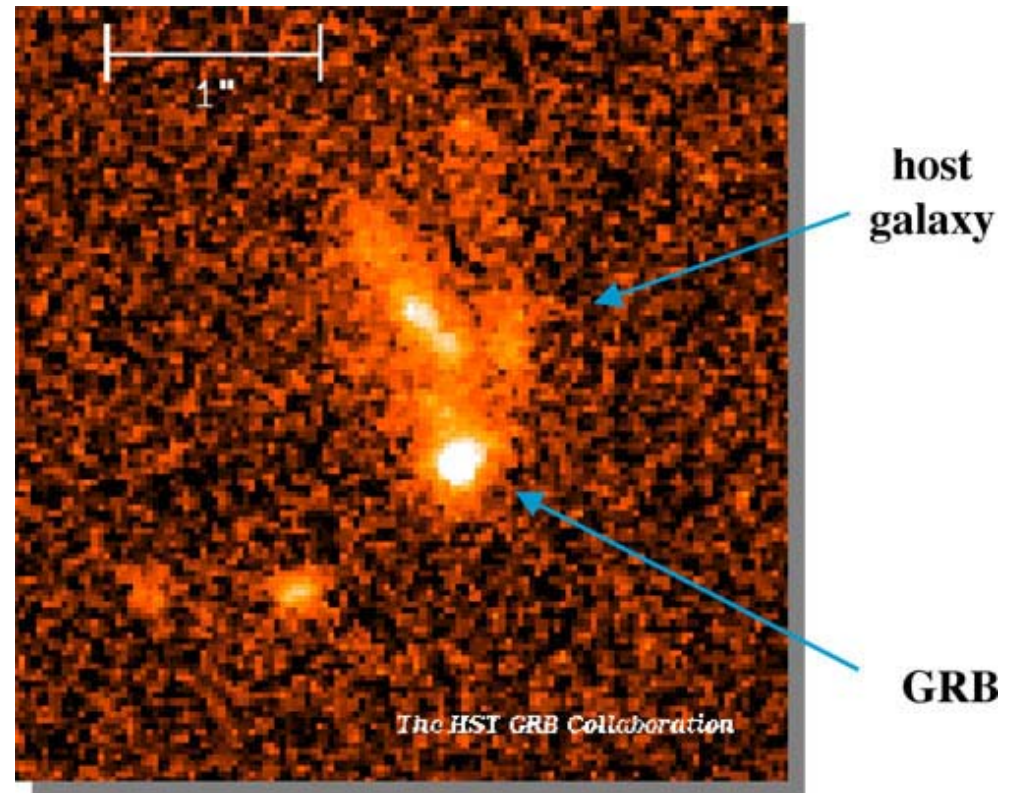
ISD Support For Launch & Early Orbit



Scientific Motivation for Swift



- Most powerful explosions in Universe
- Birth sites of black holes
- Ultra-relativistic outflows
- Relation to supernovae
- Probes of the early Universe





Swift Observatory



Instruments

- **Burst Alert Telescope (BAT)**
 - GSFC-provided
 - New CdZnTe detectors
 - Arcminute GRB positions (20 sec)
 - Hosts Figure of Merit (FoM) S/W
- **X-Ray Telescope (XRT)**
 - PSU-provided
 - Arcsecond GRB positions (100 sec)
 - CCD spectroscopy
- **UV/Optical Telescope (UVOT)**
 - PSU-provided
 - Sub-arcsec imaging
 - Grism spectroscopy
 - Finding chart (270 sec)

Spacecraft

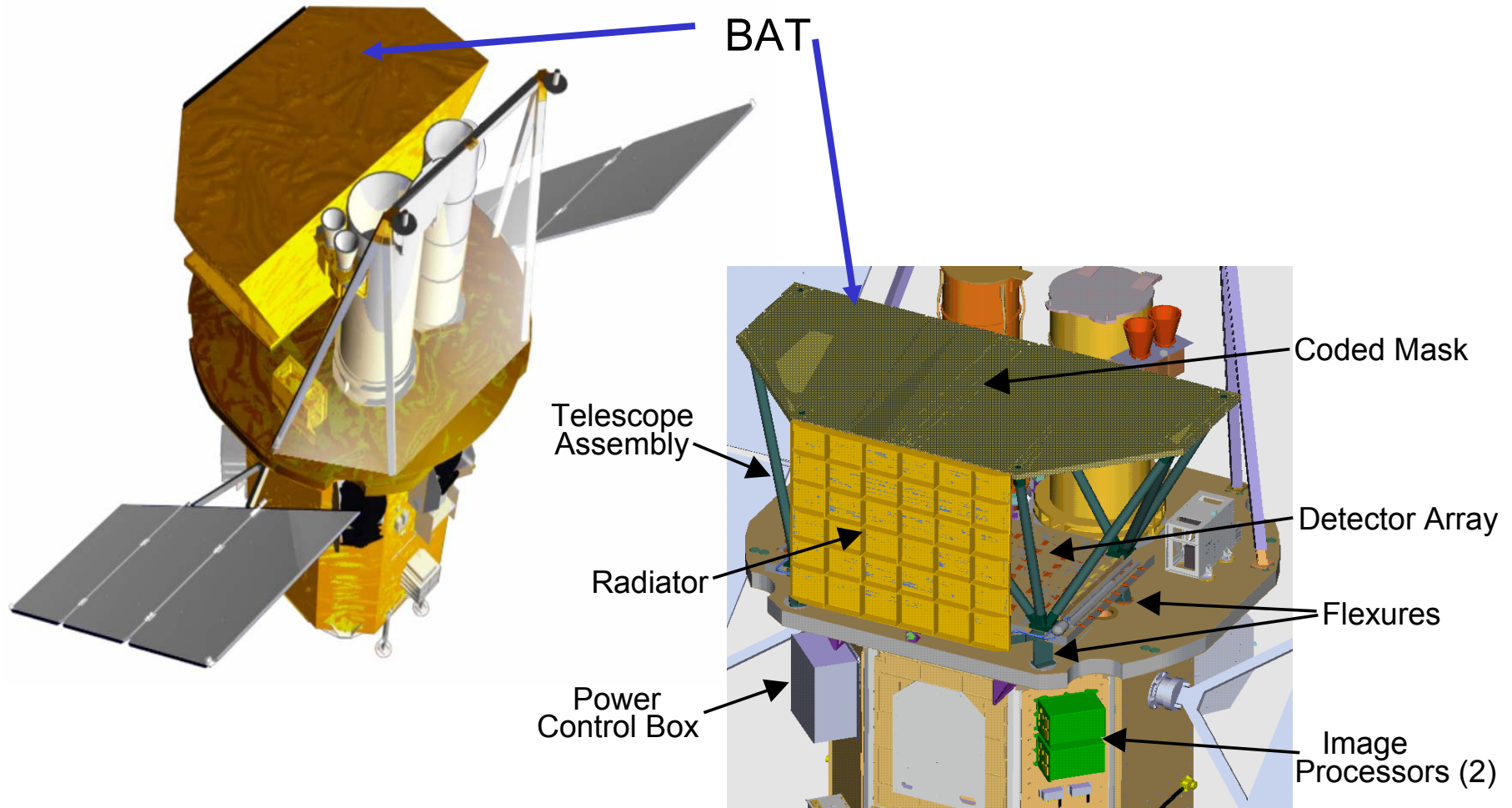
- **RSDO – Spectrum Astro**
- **Autonomous re-pointing, 20 - 75 sec**
- **Onboard and ground triggers**

BAT **UVOT** **XRT**





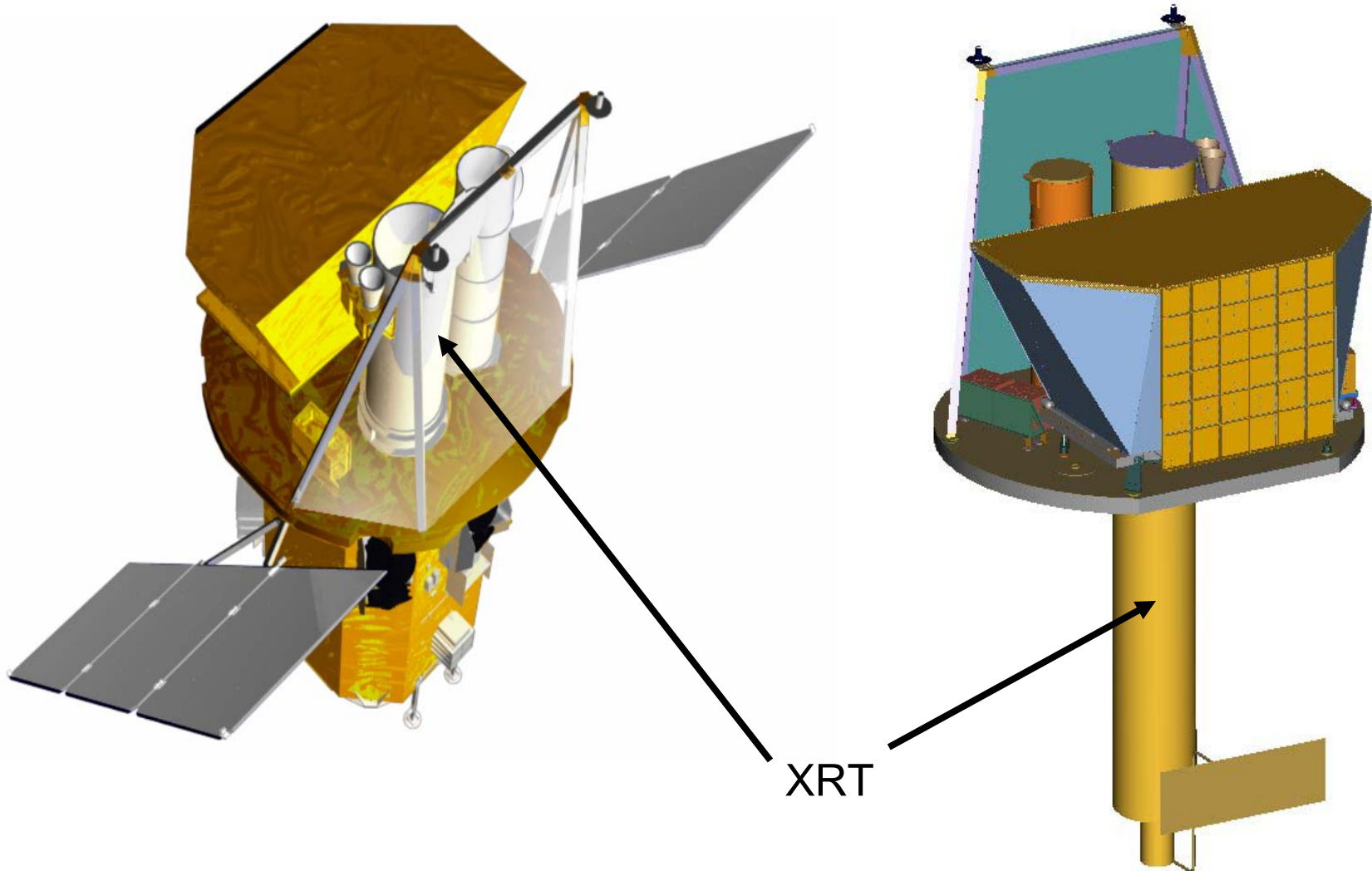
BAT Instrument



Note: Graded Z-Shields Omitted for Clarity

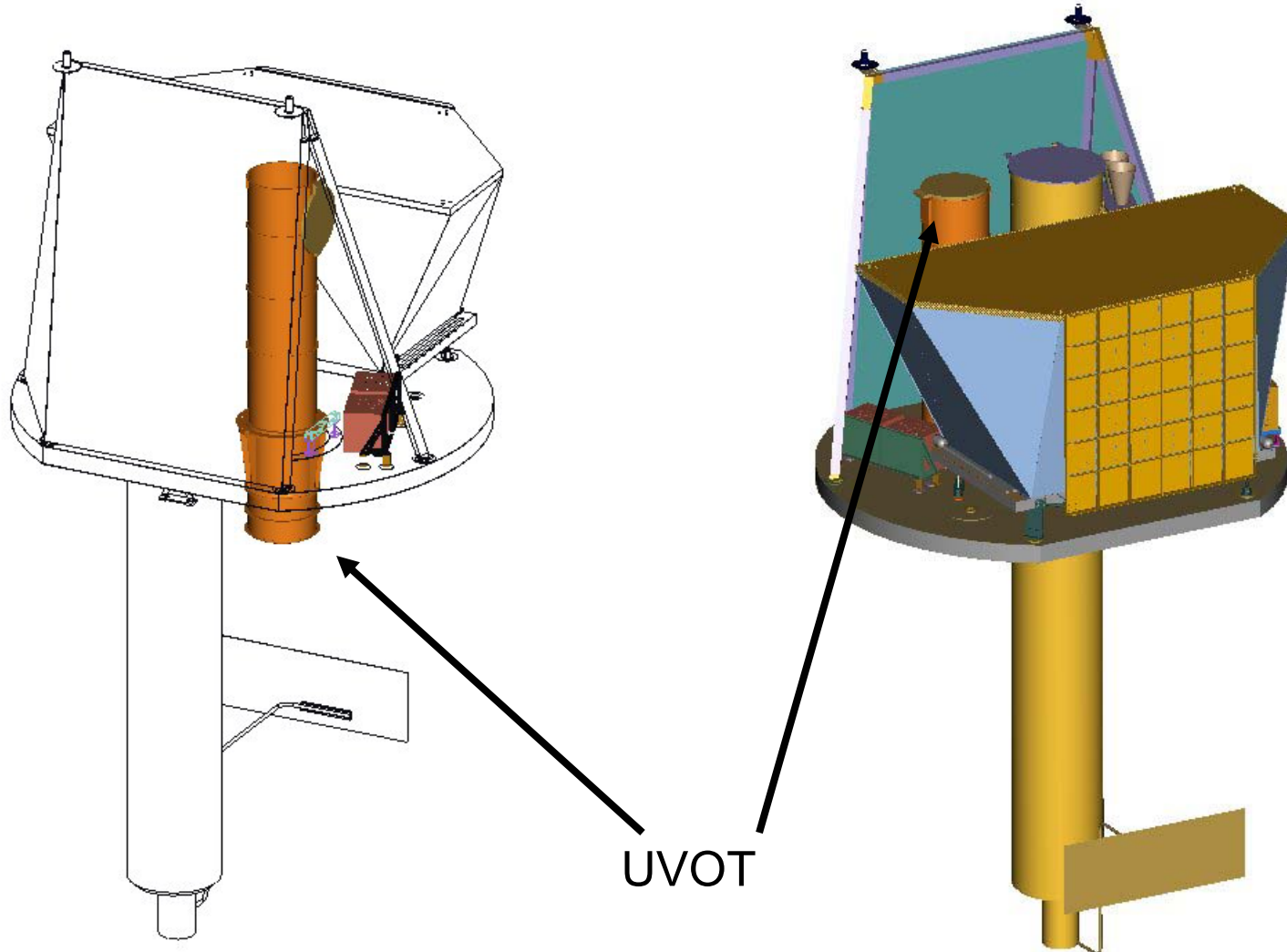


XRT Instrument





UVOT Instrument



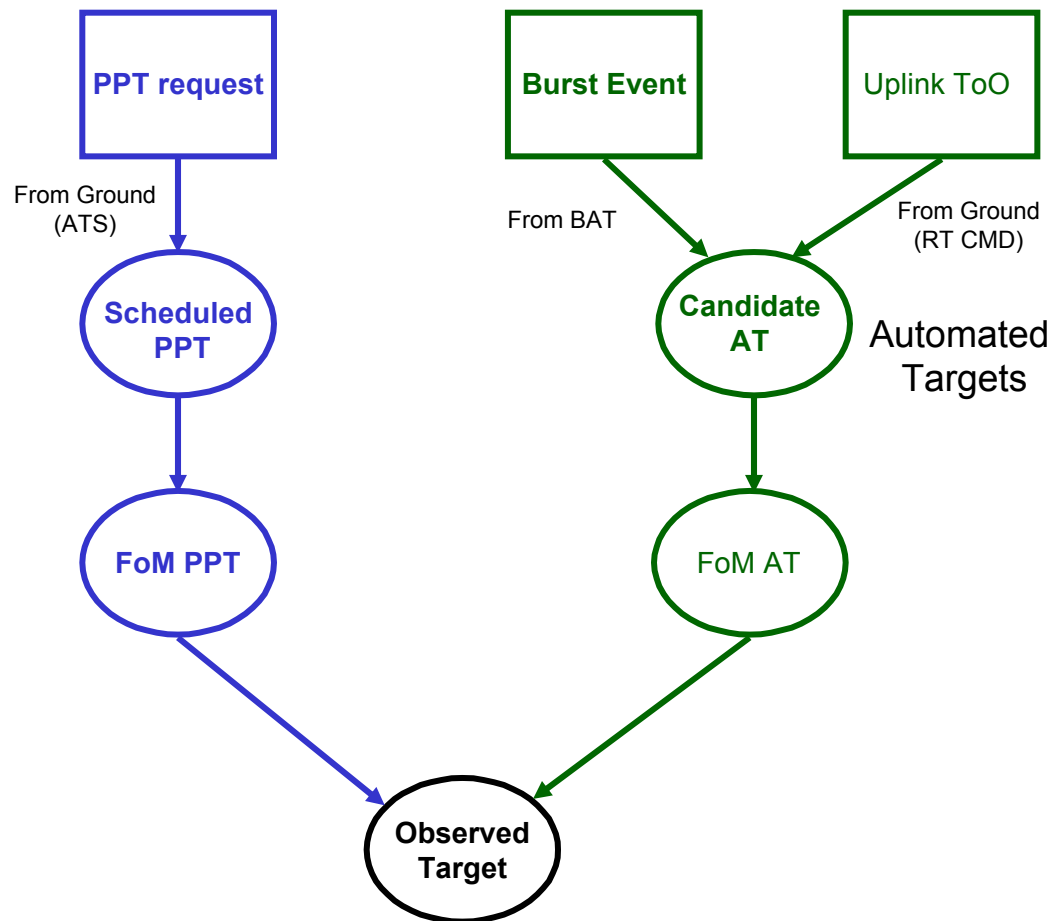


FoM Architecture



- FoM S/W Hosted in BAT IP
- Requests Slews to Pre-planned & Automated Targets (PPTs & ATs)
- Evaluates Relative Scientific Merit of Targets
- Spacecraft Checks All Viewing Constraints Before Accepting Slew Request

Pre-Planned Targets



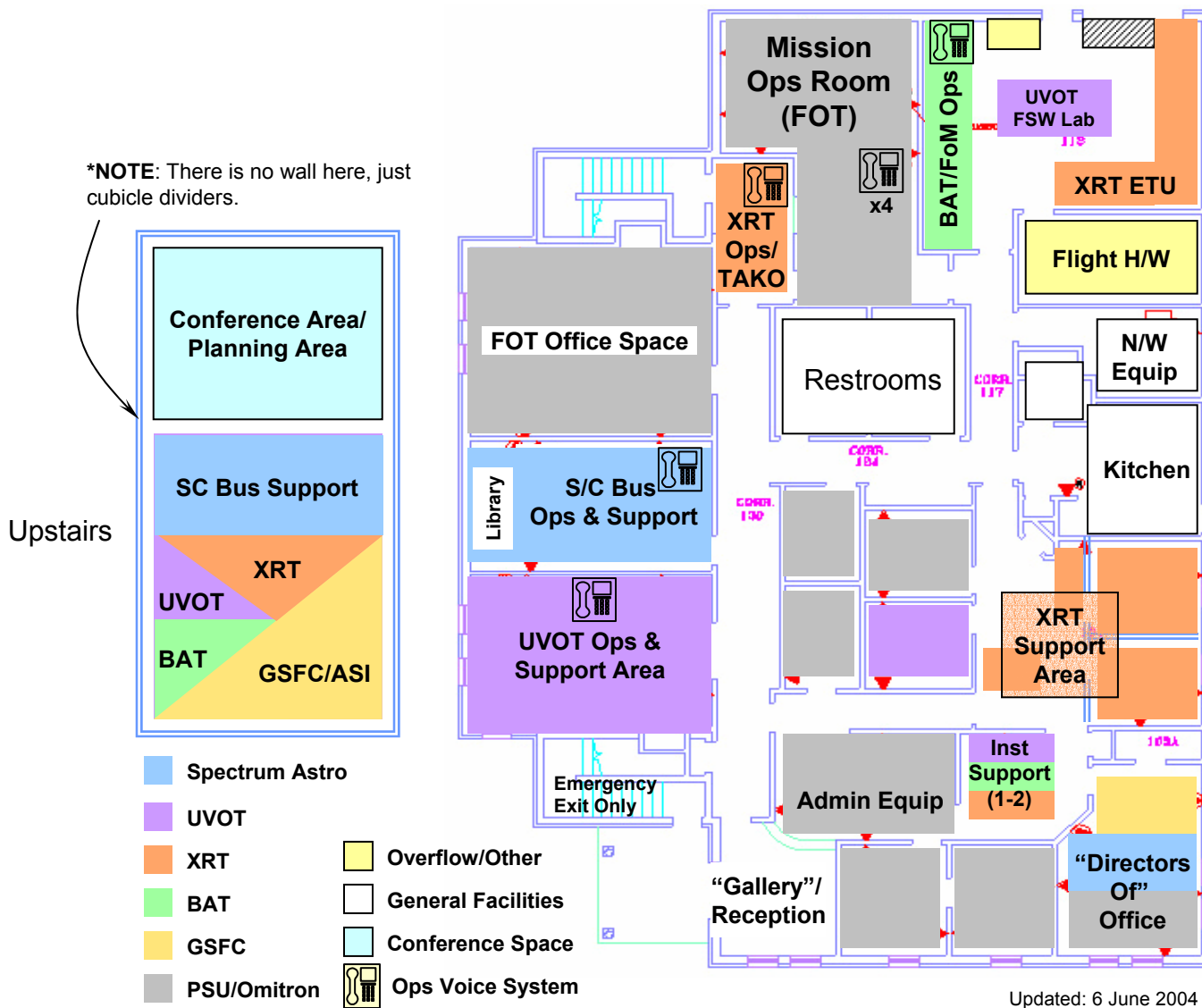


MOC Facility at PSU





MOC Facility Layout



Updated: 6 June 2004

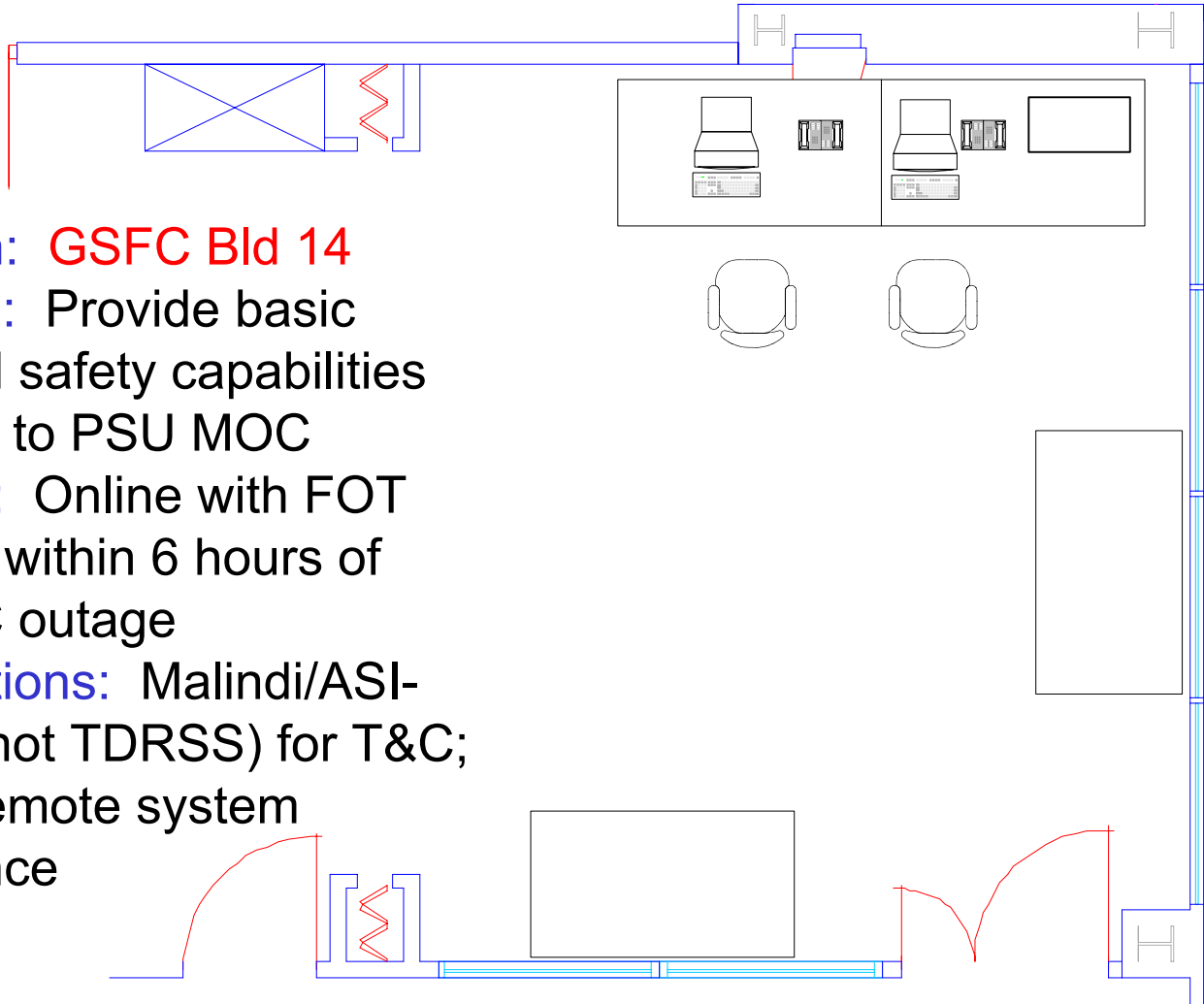


MOC Comm Links





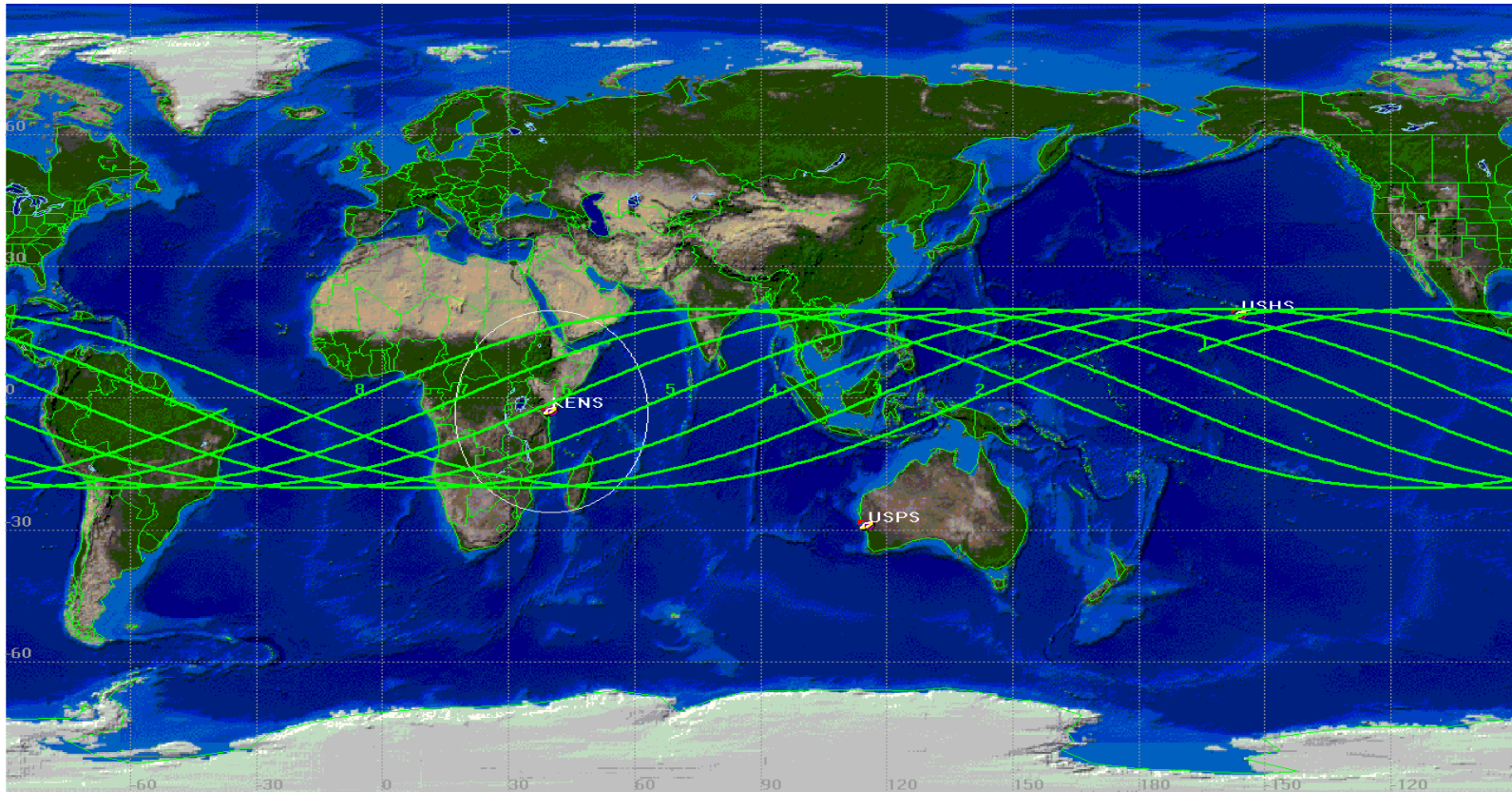
Contingency MOC Layout



- **Location:** GSFC Bld 14
- **Purpose:** Provide basic health and safety capabilities as backup to PSU MOC
- **Latency:** Online with FOT personnel within 6 hours of PSU MOC outage
- **Connections:** Malindi/ASI-Net only (not TDRSS) for T&C; CNE for remote system maintenance



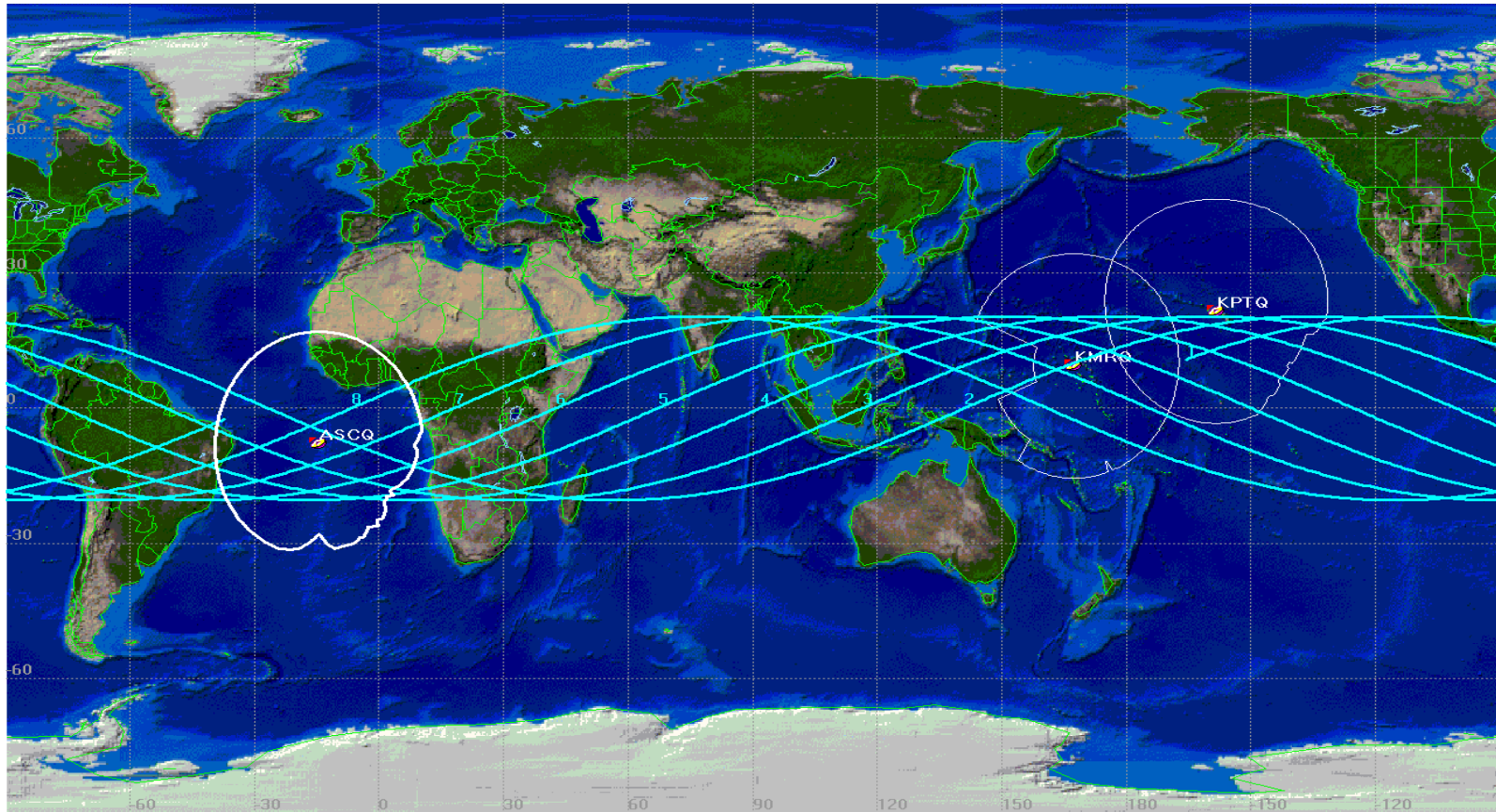
Ground Trace



**SWIFT USN and Malindi (KENS)
L&EO Coverage (8 orbits)**



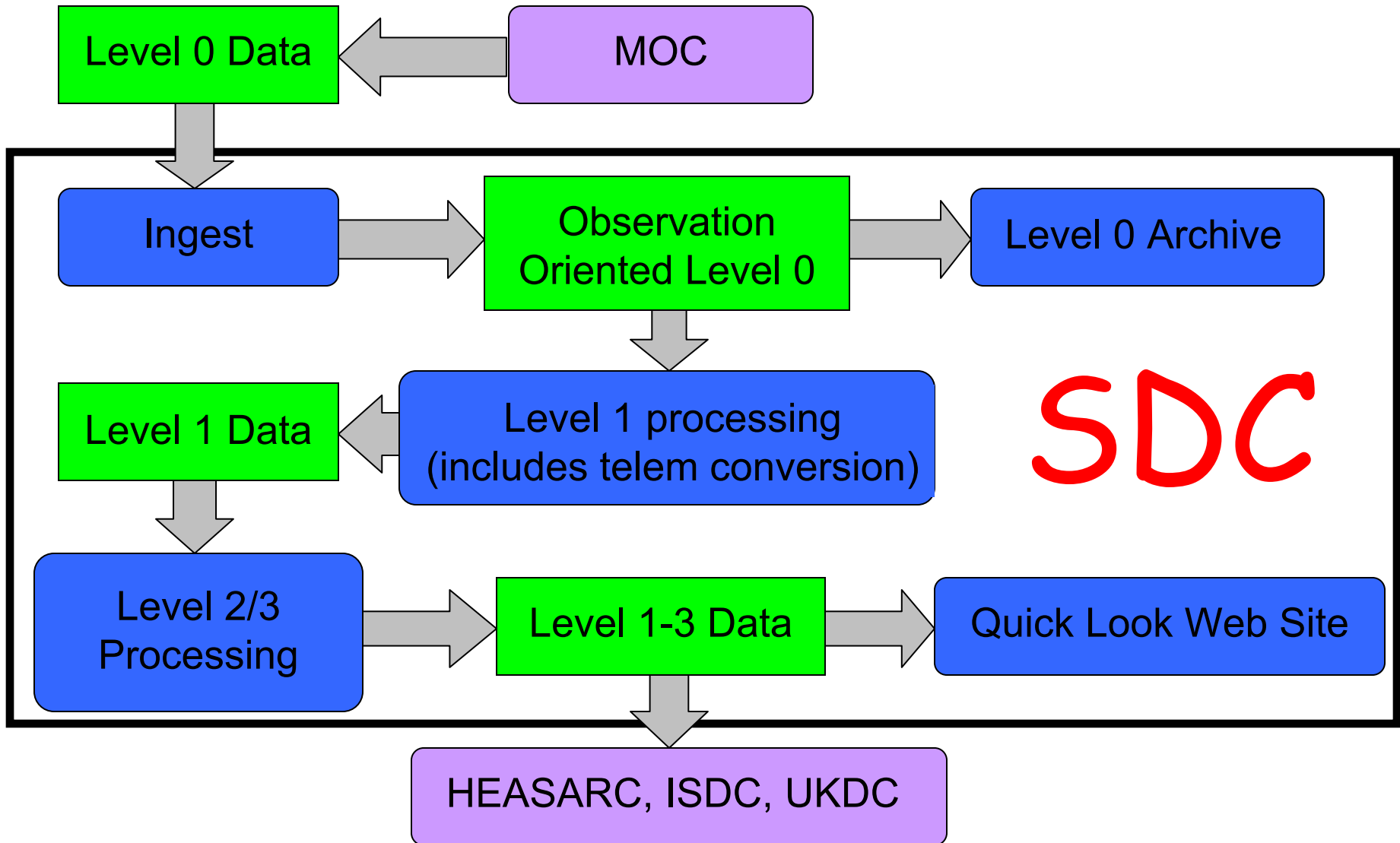
Ground Trace



SWIFT Radar C-band L&EO Coverage (8 orbits)



Science Data Flow





Spacecraft Status



Pre-Ship Review (PSR) held July 14th/15th

- ❑ 19 RFA's total, where two were considered liens against S/C ship
 - Load the latest BAT FSW at GSFC before ship
 - > Status: planned to be done prior to ship date
 - Obtain information on UVOT filter wheel stoppage that occurred during one of the observatory tests
 - > Status: According to PSU, turns out that the filter wheel didn't actually stop
- ❑ Otherwise, Board gave Project green light to ship, pending closure of the two liens (according to Joe Dezio/Project Manager)
- ❑ In the FOR Dry Run #2, a "constraint trapping" S/C FSW problem was described, that is not a ship lien, but is something that the Project wants fixed before launch
 - FSW occasionally (a few days every 6 months) does not properly handle when a viewing constraint is entered (e.g., earth limb constraint)
 - Instead of going to an alternative target, it goes into safemode
 - Spectrum Astro currently evaluating and plans to fix
 - Update will have to be loaded onto at KSC



Spacecraft Status



Spacecraft ship to KSC planned for Tue, July 27th

Launch planned for **October 7th**

- ☐ According to Spectrum Astro, have approximately 30 days of slack
- ☐ Slack has allowed them to commit to some additional (but optional) operations-oriented testing with the PSU MOC



Pre-launch Activities at KSC



Streamlined Processing

- ☐ No Propulsion System
- ☐ No Pyro Initiators
- ☐ Ship And Shoot Philosophy, Battery And Solar Arrays Ship On The Bird

Adequate Slack At CCAFS

- ☐ Many weekends available

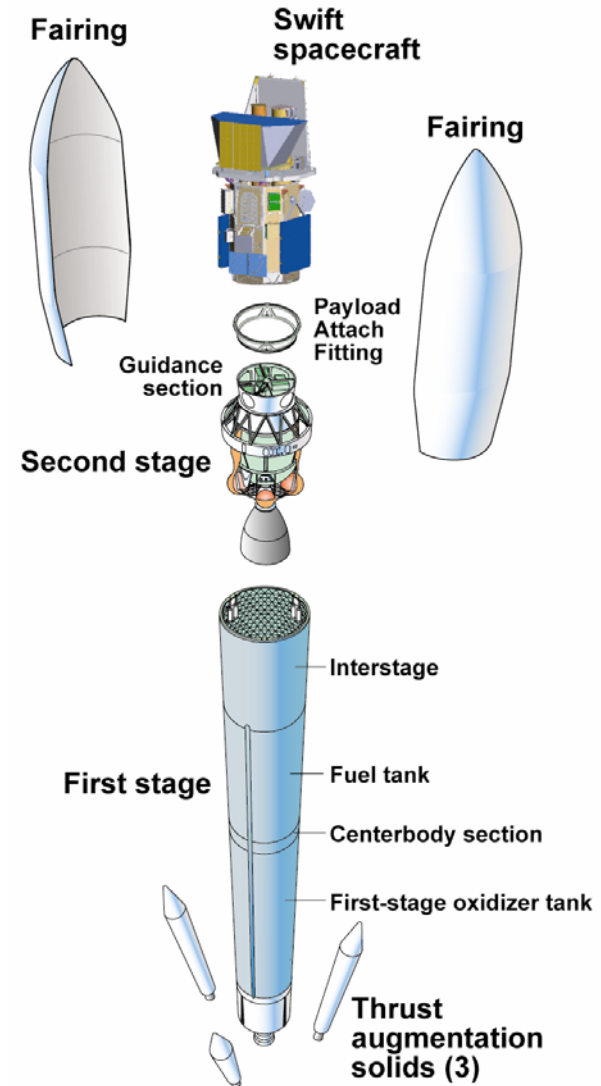
27 Jul 2004: Observatory Ship Date

29 Jul 2004: Arrival And Off-loading

T-8: Swift Erection On SLC-17A

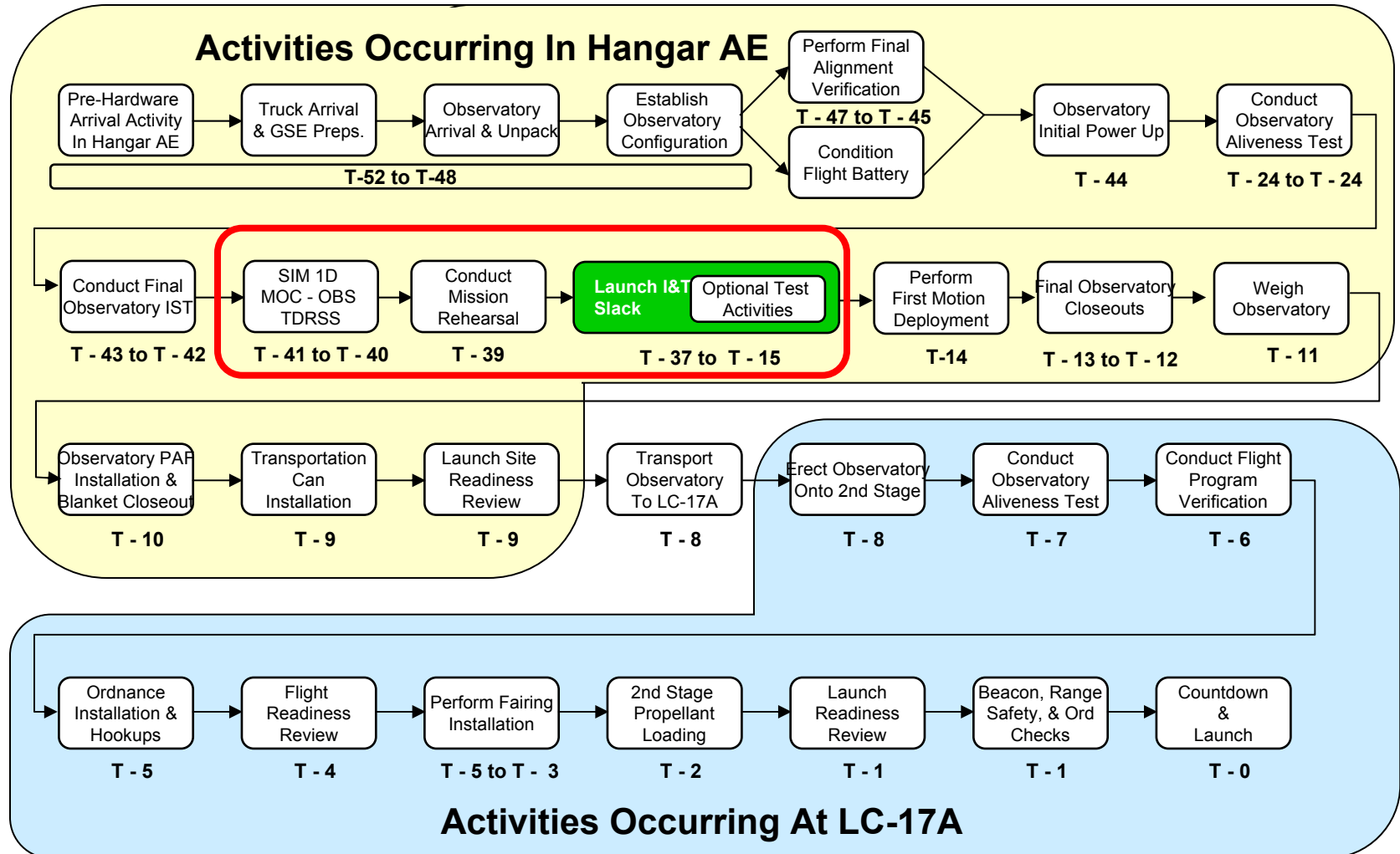
T-4: Fairing Install

07 Oct 2004: Launch





Launch Site Flow





Ground System/Ops Status



Ground system declared **ready for launch based on Mission Readiness and End-to-End Testing performed by Ground System Test Lead, Beth Pumphrey/586**

- ❑ MOC wants to install an ITOS patch to fix a problem sometimes encountered with handling science packets partially containing fill data
 - Not launch critical, and may have to be installed after launch freeze (L-60 days, Aug 7th)
- ❑ PSU performing Overflow Facility development at MOC
 - Not launch critical
- ❑ SN Demand Access Service has an open discrepancy on occasionally not being available for Burst Alerts
 - Referred to as the “Sleeping DMUs” problem
 - SN investigating, and Swift wants it fixed, but NOT launch critical



Ground System/Ops Status



Flight Operations Review (FOR) rescheduled from July 7th to Aug 3rd

- ☐ Dry Run held June 21 revealed that there was no way the ground/ops team would be ready for an FOR July 7th
 - At same time, team also had to conduct the TDRSS ETE Test, which was deemed as a higher priority
 - Delays in spacecraft schedule heavily impacting ability to complete collection of ops products (primarily Proc's and T&C Data Base)
- ☐ Review team: Steve Coyle and Mike Rackley
- ☐ Dry Run #2 being conducted now (July 20 & 22) – Day 1 revealed huge improvement so far !!!

Biggest issues revolve around the readiness of the two key operations products (Proc's and T&C data base)

- ☐ Significant work needed to complete and validate Proc's, which are being provided by Spectrum Astro and the instrument teams
- ☐ T&C DB does not yet contain complete set of discrete and limit definitions



Launch Critical Ground System Components



Launch critical:

- ☐ Malindi Ground Station and ASI_net
- ☐ SN, DAS, & WDISC
- ☐ Flight Dynamics Facility
- ☐ MOC
- ☐ SSC & SDC – Level 1 data processing (needed for instrument activation and calibration)

Not critical:

- ☐ Universal Space Network
- ☐ Contingency MOC at GSFC
- ☐ SSC & SDC data processing beyond Level 1
- ☐ Data Archives
- ☐ Gamma-ray Coordinates Network



Ground Testing Approach



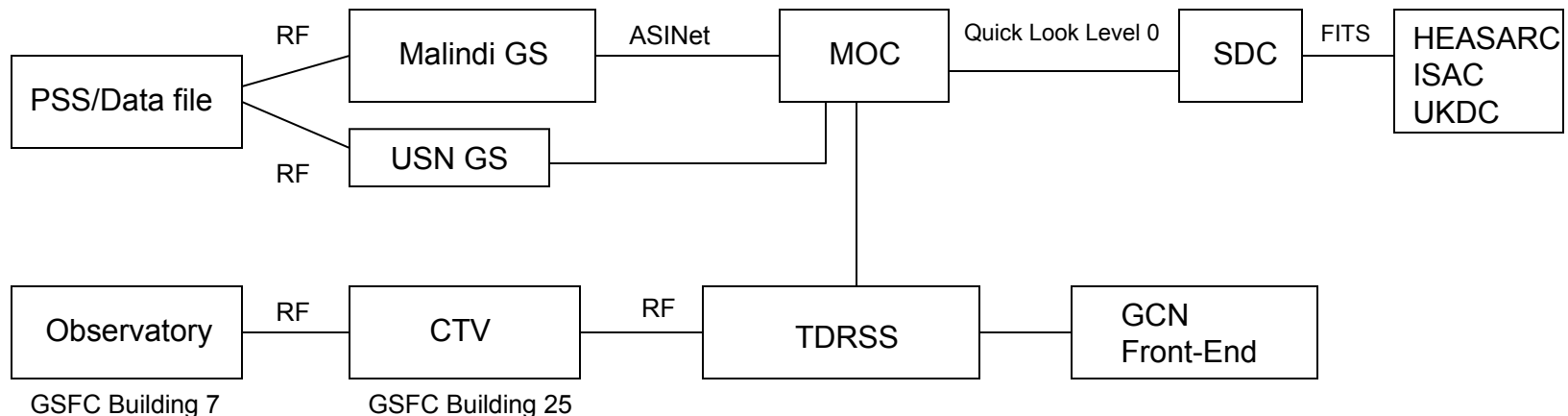
- ☐ Document tests in a Ground System Test Plan
- ☐ Test to and maintain a Ground System Test Requirements Verification Matrix
- ☐ Conduct series of formal tests to validate ground readiness
 - RF Compatibility Tests (RFCTs)
 - Spacecraft Interface Tests (SCIFs)
 - Mission Readiness Tests (MRTs)
 - End-to-End Tests (ETEs)
- ☐ Produce test documentation
 - Test Procedures/scripts
 - Test Briefing Messages
 - Test Summary Reports
 - Test Discrepancy Reports
- ☐ Manage via bi-monthly Mission Readiness Test Team
- ☐ All led by Ground System Test Lead (Beth Pumphrey)



Mission Readiness Tests (MRTs)



- ❑ MRTs are a series of tests that validate:
 - Ground system interfaces
 - Data flows
 - Requirements in GNEST Requirements Verification Matrix
 - Overall ground system performance
- ❑ Involves all ground system elements and operations data/voice links
- ❑ Portable Spacecraft Simulator (PSS), the GSFC Hotbench, the Spacecraft, and the Observatory may be used to represent the Swift spacecraft during MRTs
- ❑ MOC was located at GSFC for the first two MRTs and at PSU for the last two MRTs
- ❑ Completion of all MRTs is a prerequisite to conducting ETE tests





MRTs (con't)



□ Tests:

- MRT #1 (TDRSS) 04/03/03 **Primary Objectives Met**
 - > Verified interface between SN/DAS, SN/Legacy MA and SN/Legacy SSA and the MOC and GCN
 - > Telemetry includes spacecraft and instrument HK data and simulated burst alerts at 1 and 4 kbps data rates
 - > Command data on both Legacy MA and SSA system
- MRT #2 (Malindi) 01/24/03 **Primary Objectives Met**
 - > Verified interface between Hotbench, Malindi RF Suitcase and GSFC MOC
- MRT #3 (Malindi) 07/14-15/03 **Primary Objectives Met**
 - > Verified interface between Malindi GS and PSU MOC
 - > Verified interface between PSU MOC and SDC and between SDC and data centers
- MRT #4 (USN) 12/04/03 **Primary Objectives Met**
 - > Verified interface between USN GS and PSU MOC



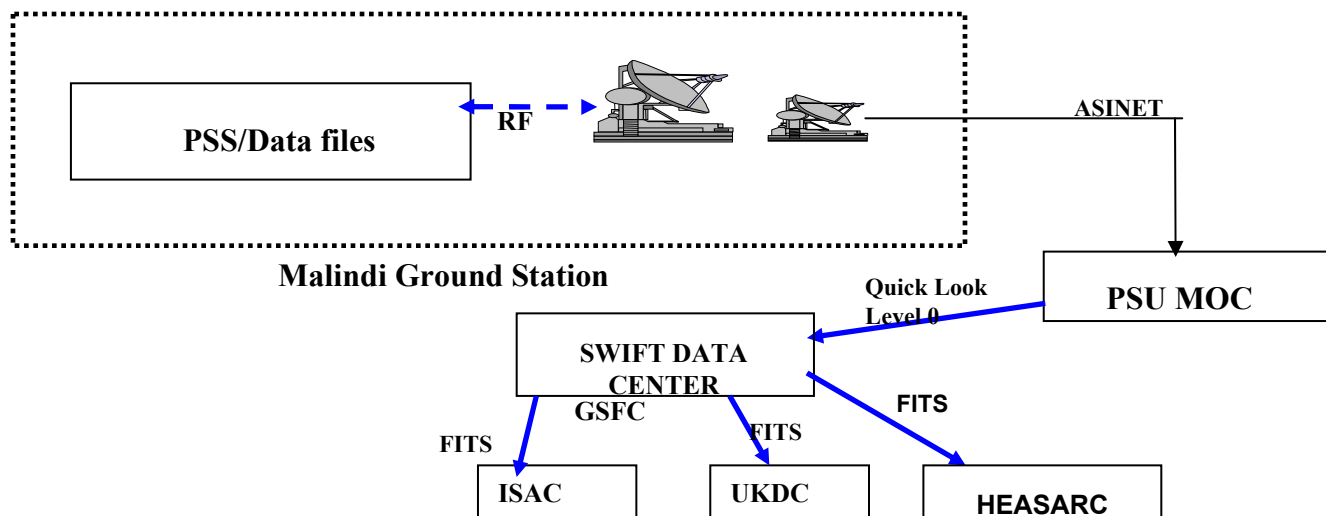
Malindi End-to-End (ETE) Test



End-to-End tests validate the data flow between the observatory/PSS and the entire ground system in a mission configuration.

❑ Malindi ETE 6/16-17/04 Primary Objectives Met

- Actual, simulated, and recorded Observatory telemetry from Malindi, using PSS, to PSU MOC
- Command data from PSU MOC to Malindi
- Quick Level 0 data from PSU MOC to SDC
- Higher level data products from SDC to HEASARC, ISAC, and UKDC
- Data centers make data public



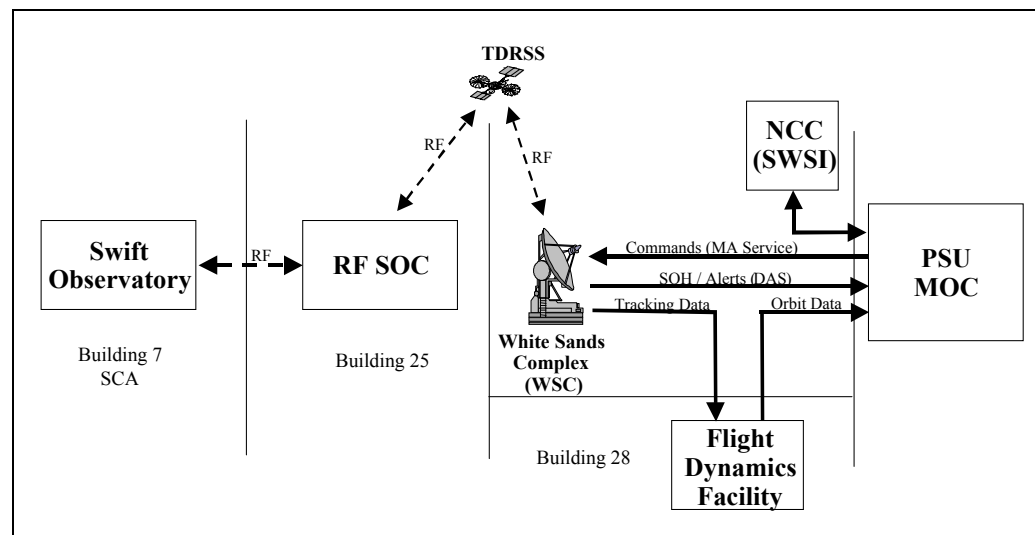


TDRSS ETE Test



❑ TDRSS ETE 6/30/04 **Primary Objectives Met**

- Telemetry data from Observatory in GSFC I&T to PSU MOC
- Command data from PSU MOC to Observatory
- Burst Alerts from Observatory to PSU MOC and GCN
- Burst messages from GCN to public
- Tracking data from WSC to FDF
- Target of Opportunity (ToO) notification





ISD Support For Launch & Early Orbit



ISD providing direct L&EO support:

- ❑ Lou Parkinson – on-site support at PSU MOC during L&EO (30 days)
- ❑ Howard Dew – on-site support at KSC before launch to support pre-launch network configuration, testing, etc.
- ❑ Mike Rackley – on-site support at Malindi Ground Station for first week
- ❑ BAT FSW team – on-site at PSU MOC to support initial BAT activation (starting around Day 4, going for a few days)
- ❑ John Ong & FoM FSW team – on-site at PSU MOC to support FoM activation (starting around Day 17, going for a few days)